

"Express Mail" mailing label number: EV 329459405US

Date of Deposition: July 3, 2003

Our Case No.10541-1744

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
APPLICATION FOR UNITED STATES LETTERS PATENT

INVENTOR(S):	Andrew Z. Glovatsky and Vladimir Stoica
TITLE:	MICROELECTRONIC PACKAGE WITH TUBULAR HOUSING
ATTORNEY(S):	Douglas D. Fekete BRINKS HOFER GILSON & LIONE P.O. BOX 10395 CHICAGO, ILLINOIS 60610 (734) 302-6000

MICROELECTRONIC PACKAGE WITH TUBULAR HOUSING

TECHNICAL FIELD OF THE INVENTION

[0001] This invention relates to a microelectronic package contained in a tubular housing. More particularly, this invention relates to such microelectronic package wherein a microelectronic assembly, which includes electronic components mounted on the substrate that is affixed to a support and disposed within the tubular housing spaced apart therefrom.

BACKGROUND OF THE INVENTION

[0002] A microelectronic assembly comprises electronic components mounted on a printed circuit board which may be a rigid board or a flexible membrane. The assembly is typically protected by a housing, the size and shape of which is determined by the nature of the product. In some instances, it is desired to locate the microelectronic assembly within a tubular housing. For example, in military missiles, the housing may have a cylindrical shape. The microelectronic assembly may be arranged so that the printed circuit board is perpendicular to the central axis of the housing. Additional components, which may include batteries, gyroscopic components, motors or ordinance, may be disposed within the remaining volume of the housing. However, this perpendicular arrangement blocks coolant gas flow through the housing and thus does not provide adequate thermal dissipation for heat generated by microelectronic components during use. Alternately, the printed circuit boards may be disposed parallel to the axis to facilitate coolant gas flow through the housing. However, the printed circuit boards then divide the housing in a manner that does not provide a suitable volume for conveniently receiving other components.

[0003] Therefore, a need exists for an improved arrangement of a microelectronic assembly within a tubular housing that provides for efficient use of packaging volume by maximizing the space available for other components, and also provides for enhanced thermal dissipation by facilitating coolant gas flow about the microelectronic components.

SUMMARY OF THE INVENTION

[0004] In accordance with this invention, a microelectronic package is provided that comprises a tubular housing having a circumferential wall that defines a compartment. A microelectronic assembly is affixed to a support that is received in the compartment. The microelectronic assembly includes a substrate having a major surface and is carried on the support such that the major surface faces the circumferential wall and is spaced apart therefrom. By arranging the microelectronic assembly proximate to the walls, the package permits other components to be located within the interior volume of the support. Moreover, the microelectronic package provides spacing between the microelectronic assembly and the tubular housing to facilitate coolant gas flow. Therefore, the microelectronic package of this invention provides both an efficient use of packaging volume and enhanced thermal dissipation.

SUMMARY OF THE FIGURES

[0005] This invention will be further illustrated with reference to the accompanying drawings wherein:

[0006] Figure 1 is a perspective view of a microelectronic package in accordance with a first preferred embodiment of this invention;

[0007] Figure 2 is a perspective view of a microelectronic assembly that is a component of the microelectronic package in Figure 1;

[0008] Figure 3 is a perspective view showing a microelectronic assembly and a support for the microelectronic package in Figure 1;

[0009] Figure 4 is an end view of the microelectronic package in Figure 1;

[0010] Figure 5 is a microelectronic package in accordance with a second embodiment of this invention;

[0011] Figure 6 is an exploded perspective view showing the microelectronic assembly and support for the microelectronic package in Figure 5;

[0012] Figure 7 is a perspective view showing a microelectronic package in accordance with a third embodiment of this invention; and

[0013] Figure 8 is an exploded perspective view showing microelectronic assemblies and supports for the microelectronic package in Figure 7.

DETAILED DESCRIPTION OF INVENTION

[0014] In accordance with a preferred embodiment of this invention, referring to Figures 1 through 4, a microelectronic package 10 comprises a tubular housing 12 that is cylindrical about an axis 14. By way of a preferred example, housing 12 may be a segment of a casing of a missile. Housing 12 includes an inner wall 16 that defines a compartment 18 for containing microelectronic circuit elements.

[0015] Package 10 further comprises a microelectronic assembly 20, which is depicted in Figure 2 in a planar configuration adapted for

manufacture and prior to assembly in package 10. In this embodiment, assembly 20 comprises a plurality of substrates 22 which are preferably rigid FR4 boards. Substrates 22 comprise first major faces 24 onto which electronic components 26 are mounted and connected by metallic traces (not shown). Substrates 22 also include a second major face opposite face 24, to which electronic components and circuit traces may also be attached. It is pointed out that edges 30 of substrates 22 are spaced apart, with circuit traces on adjacent boards being interconnected by flexible interconnects 28.

[0016] Assembly 20 is mounted on a support 32 that is sized and shaped to be axially received in housing 12. Support 32 is preferably an integral, self-sustaining cage formed of metal or plastic and comprising axial ribs 34 connected by end frames 36 to form a polygonal prismatic structure. Adjacent ribs 34 are spaced apart by segments of end frames 36 to define a cell sized and shaped to receive a substrate 22 of assembly 20. Assembly 20 is mounted onto support 12 with edges 30 of each substrate 22 attached to the adjacent ribs, and with flexible interconnects 28 bridging ribs 34 between adjacent substrates to interconnect the electrical circuits thereon.

[0017] Support 32 further includes spacers 38 that extend radially outward and engage inner wall 16 of housing 12. In the depicted embodiment, spacers 38 protrude from end frames 36. Alternately, spacers may extend from ribs 34. Spacers 38 space apart substrates 22 from housing 12 to provide clearance for electronic components 26. In addition, the spacing between the housing and the microelectronic assembly 20 forms a peripheral passage through which air or other coolant gas may be conveyed. During use, heat is generated by electronic components 26 and is extracted

by cooling gas flowing through the peripheral space about microelectronic assembly 20.

[0018] It is an advantage of this invention that support 32 arranges microelectronic subassembly proximate to housing 12. As a result, the subassembly of support 32 and microelectronic assembly 20 defines an interior chamber 40 for receiving other components. In the depicted embodiment, a battery 42 is inserted into chamber 40 and connected by flexible interconnects 44 to microelectronic assembly 20 for purposes of powering the electrical circuits thereon. Alternately, chamber 40 may suitably contain a gyroscopic component, a global positioning system, ordinance, or other components of the product.

[0019] Therefore, this invention provides a package 10 that includes a microelectronic assembly 20 mounted on a support 32 and received in a housing 12. Assembly 20 is arranged proximate to housing 12 to provide an inner chamber 40 for receiving other components. The major faces 24 of microelectronic assembly 20 that include electronic components 26 face housing 12 and are spaced apart to accommodate coolant gas flow. Therefore, package 10 provides both an efficient use of packaging space and also enhances thermal dissipation by coolant gas flow during use.

[0020] In the embodiment depicted in Figures 1 through 4, microelectronic assembly 20 is formed a multiple rigid printed circuit boards. Alternately, microelectronic assembly 20 may be formed of flexible substrates that are held in a planar configuration by the support to minimize flexure that might otherwise damage the electrical circuits during use. In yet another alternative, assembly 20 may be formed of a single flexible substrate that is

wrapped about support 32, including overlying ribs 34. Also, in the embodiments depicted in Figures 1-4, support 32 includes spacers 38 for spacing assembly 20 apart from inner wall 16 of housing 12. Alternately, spacers may be provided on inner wall 16, or may be provided by separate elements.

[0021] Referring now to Figures 5 and 6, there is depicted an alternative embodiment of a microelectronic package 60 in accordance with this invention. Package 60 includes a housing 62 that is cylindrical about an axis 64 and comprises an inner wall 66 that defines a compartment. In this embodiment, package 60 includes a microelectronic assembly 70 formed of flexible substrates 72 having a major face 74 onto which electronic component 76 and circuit traces (not shown) are attached. Circuits on adjacent substrates 72 are interconnected by flexible interconnects 78. Also in this embodiment, microelectronic assembly 70 is affixed to a support 80 that is a hollow cylinder formed of metal or plastic and coaxially arranged within housing 62. Support 80 comprises an assembly support surface 81 and axial spacers 82 that protrude from surface 81 and engage inner wall 66 of housing 62 to space apart microelectronic assembly 70 from the housing to provide clearance for electronic component 76 and to form peripheral passages for conveying coolant gas during use. It is a feature of this embodiment that support 80 defines an inner chamber 84 for receiving other components, and also provides a solid, protective wall dividing the microelectronic assembly from the components within the inner chamber. Thus, package 60 provides both an efficient use of packaging volume and

thermal dissipation by cooling gas flow through the peripheral passages about microelectronic assembly 70.

[0022] Referring to Figures 7 and 8 that includes multiple subpackages 102, 104 and 106 that are concentrically received in a housing 108 that is cylindrical about an axis 110. Each subpackage 102, 104 and 106 comprises a microelectronic assembly 112, 114 and 116, respectively, that is mounted on a support 118, 120 and 122, respectively, which are substantially similar to the arrangement of microelectronic assembly and support of package 60 in Figures 4-6, but are progressively sized. Subpackage 102 is received in housing 108 so that spacers of support 118 engage the housing to position the structure therein. Subpackage 102 defines an inner chamber 124 into which is received subpackage 104, with the spacers of support 120 engaging inner chamber 124. Similarly, subpackage 104 defines an inner chamber 126 into which is received subpackage 106, with the spacers of support 122 engaging structure 104. Subpackage 106 includes an inner chamber 128 into which other components may be suitably packaged. Thus, in this example, subpackage 102 forms a housing for receiving subpackage 104, and subpackage 104 forms a housing for receiving subpackage 106. In each instance, the subpackage includes a microelectronic assembly mounted on a support that is spaced apart from its housing to define passages for conveying coolant gas during use. Moreover, the subpackage defines chambers for receiving additional components, which, for subpackage 102, includes the additional subpackages 104 and 106.

[0023] Therefore, this invention provides a microelectronic package wherein microelectronic assemblies are mounted on a support, which may be

a cage or solid structure, and are inserted within a tubular housing. The microelectronic assemblies comprise substrates having major faces that face the housing and are spaced apart to define passages about the microelectronic package for coolant gas flow during use. Nevertheless, the assemblies are disposed proximate to the housing to provide an optimum volume for containing additional components.

[0024] While this invention has been described in terms of certain embodiments thereof, it is not intended to be so limited, but rather only to the extent set forth in the claims that follow.